A Disconnect for NTT Labs?

A proposal to break up Nippon Telegraph & Telephone Corp. (NTT) has sparked debate among scientists, industry, and government officials about its impact on one of Japan's leading industrial laboratories

TOKYO—Scientists at Nippon Telegraph & Telephone Corp. (NTT) have long cast an admiring eye on the former AT&T Bell Laboratories, viewing it as a model of how a big corporate lab should mix basic and applied research. But they are horrified by a recent recommendation—to break up the parent company and dismember its labs—that might force them to follow too closely in Bell Lab's recent footsteps.

On 29 February a government advisory panel proposed that Japan's largest communications company be split into separate regional service providers and a long-distance phone company. The recommendation, from a committee of business leaders, academics, and consumer activists known as the Telecommunications Council, argues that splitting up NTT would encourage competition and help stimulate growth in activities in which Japan is lagging, such as e-mail and computer networking. Moreover, "greater competition will result in revitalized R&D activities and further promotion of basic and leading-edge research," the council said in a report to the Ministry of Posts and Telecommunications.

But NTT and its allies see a darker lesson in what has happened in the United States after the breakup of AT&T in 1984: "It resulted in a significant decline in the capabilities of Bell Labs," says Tadahiro Sekimoto, the influential chair of NEC Corp., one of several leading industrialists who hope to prevent the same thing from happening in Japan. Sekimoto and others argue that breaking up NTT would sap the strength of the company's $2.9-billion-a-year research effort and inflict serious damage on basic science in the country.

The proposal, part of a package of reforms to deregulate the country's telecommunications system, is a political hot potato. In the short run, opposition to the council's report from NTT and Japan's labor unions, which fear widespread job losses, could scuttle the council's plan. Indeed, on 29 March the government announced that it would delay any decision until next year to have more time to study the matter.

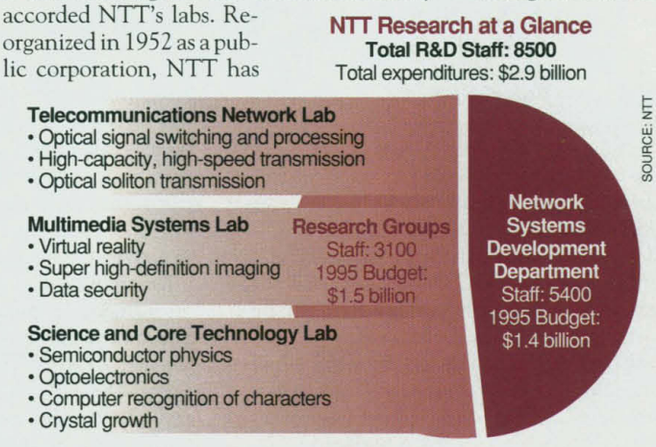
But the idea of reshaping NTT is likely to remain on the political front burner as pressure builds to open up Japan's telecommunications market. The debate stirred up by these recommendations is also focusing attention on the role and quality of NTT's massive research enterprise. In a discussion that bears a striking similarity to the debate about the fate of Bell Labs, NTT's supporters want the company's research centers preserved as a unique national asset, while critics say that changes are needed to keep Japan in the race for technical leadership in global telecommunications.

A special place

The fact that this debate is taking place at all is remarkable, given the esteem historically accorded NTT's labs. Reorganized in 1952 as a public corporation, NTT has played a pivotal role in the country's research enterprise. Its 8500 scientists carry out basic and applied work in telecommunications technologies that is passed along to outside electronics firms—including NEC and Toshiba—because the company lacks its own manufacturing facilities. Those favored companies incorporate these advances into commercial products that are then supplied to NTT and sold overseas. That system is changing, however, as the company was privatized in 1985 and foreign firms now compete to develop NTT's technology. But the government still owns two-thirds of the company's stock, and many think its labs continue to play an important role in the nation's research infrastructure.

"NTT's research laboratories are unique," says former NTT researcher Yoshihisa Yamamoto, now at Stanford University. NTT scientists, he notes, fill an important gap between the knowledge-based work at universities and the national institutes and the short-term research of the typical corporate lab. "In terms of support and freedom, the situation for doing basic research here is one of the best in the world," says Arturo Chavez-Pirson, a Canadian physicist in NTT's Basic Research Laboratories who is one of a small but growing number of non-Japanese scientists recruited to introduce heterogeneity into the labs.

Chavez-Pirson believes NTT's basic labs are developing the same culture of discovery that pervaded AT&T's Bell Labs a generation ago. And a recent analysis by the Institute for Scientific Information (ISI) in Philadelphia backs him up. The number of papers produced by NTT researchers has risen by 35% in the 10 years since NTT's privatization, according to ISI (see next page). In addition, NTT scientists turned out nearly three-fifths as many papers in 1994 as did their AT&T counterparts, despite having only one-third the number of researchers.



Up for grabs? Three laboratories carry out the bulk of NTT's research, which could be divided between two regional companies.

Those numbers parallel a corporate decision in 1985 to boost spending on fundamental research, a common practice for high-tech companies during Japan's economic boom years. "We felt we had to start taking responsibility for our own basic research," says Tetsuhiko Ikegami, an NTT senior vice president and head of NTT's Basic Research Laboratories.

In a briefing last fall, however, officials from the telecommunications ministry questioned whether the country was getting value for this investment. They presented data indicating that NTT's research budget was only 8% lower than AT&T's even though it supported one-third as many researchers. The reason, says Ikegami, is that the ministry used the actual yen-dollar exchange rate. "For purchasing power parity, the exchange rate should be around 200 yen to the dollar, not 111," he says.

A ministry official, speaking on background, also questioned whether NTT's basic research was really up to world standards. On that score, ISI's numbers offer some ammunition to NTT's critics: Over a 15-year

period in all fields, Bell Lab researchers earned an average of 7.4 citations per paper, while the comparable number at NTT was only 2.9. And the gap widened over the span. AT&T's citation impact (number of citations divided by number of papers) rose steadily through the 1980s before leveling off in the 1990s, while NTT's has stayed relatively flat.

Ikegami defends the company's research efforts, singling out a body of recent work in optoelectronics and studies of quantum effects in semiconductor devices that has attracted worldwide attention. Chavez-Pirson's group, for example, reported in 1994 that it had pushed lasers to new levels of minuteness and efficiency with the world's first quantum wire microcavity semiconductor.

Yasuaki Masumoto, a professor of physics at the University of Tsukuba, says it is hard to generalize about NTT's labs overall, but he agrees that the groups working on nanometer-scale semiconductor devices "are very strong, even when looked at from a global perspective." Izuo Hayashi, a recently retired physicist and a pioneer of the field of optoelectronics while at Bell Labs in the 1970s, says "NTT has been making some contributions to the advancement of [optoelectronics]." But he doesn't think those contributions match what Bell Labs was doing 10 to 20 years ago.

Ikegami readily acknowledges that NTT's research labs have a long way to go before they match the quality of work done at AT&T. "AT&T has a legacy of outstanding research," he says. "We are still striving to match that standard of work."

A basic challenge

Regardless of the quality of NTT's research, there is a widespread perception that Japan is seriously lagging behind other countries—particularly the United States—in the use of information and communication technologies. The Telecommunications Council noted that, on a per capita basis, the United States has six times the number of e-mail subscribers as Japan, three times the number of computer databases, and 11 times as many host computers connected to the Internet. It also cited a 1994 survey by Japan's Science and Technology Agency that found a majority of high-tech corporate executives believe that Japan is seriously lagging the United States in the communications and electronics sectors. "Japan had been emphasizing the wrong set of technologies," says Jiro Kokuryo, assistant professor of information systems at Keio University Business School. "Use of smaller computers, rather than mainframes, lagged in Japan; consequently the related research lagged." Adds Stanford's Yamamoto, who still serves as an adviser to NTT, "Japan's R&D in computers and networks is 10 years behind the U.S., [although] NTT is not solely responsible for this."

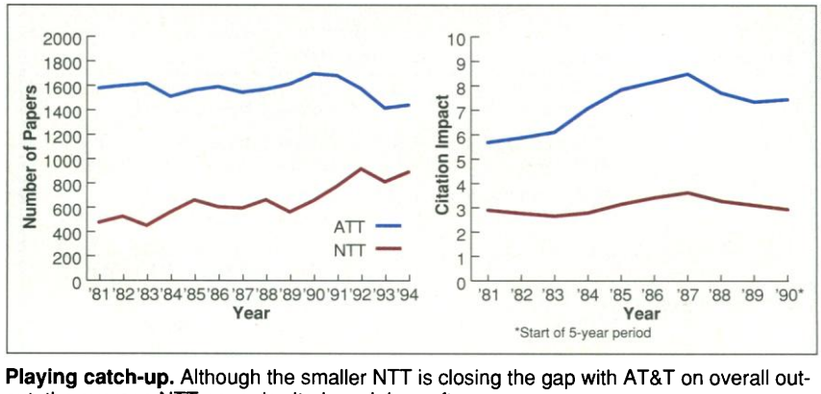
In early 1994 NTT took a few steps to help close the gap by forming a Multimedia System Laboratory Group to study software, networking, and technologies aimed at expanding use of the Internet. NTT has also agreed to develop future interactive technologies in partnerships with Silicon Graphics Inc. and Microsoft Corp.

But the Telecommunications Council would go much further. Its plan would split NTT into three separate companies, one a long-distance carrier and two to provide local phone services, with the dividing line just west of Tokyo. The report envisions NTT's R&D facilities as being "mostly inherited" by the eastern regional company, apparently because most of NTT's present research labs happen to be located in that region, although the western regional company would contribute to the research budget.

NTT supporters believe such an arrangement would doom basic research. Ikegami fears the research labs could eventually go the way of Bellcore, which was formed to serve the research needs of the new regional phone companies. Bellcore has recently been put on the market (*Science*, 2 June 1995, p. 1268), a victim of the regional companies' divergent strategies.

Even if union opposition sinks this particular plan—so far, none of Japan's political parties seems willing to take it up—NTT may still face wrenching changes that could affect its research activities. The Telecommunications Ministry, politicians, and industrial leaders all support further deregulation, and the fear is that this new competition will squeeze out research that does not directly—and fairly quickly—contribute to the bottom line. "We want to maintain our support for basic research," Ikegami says, "but it's likely to be an increasingly difficult challenge to do so." Bell Labs and Bellcore have already found that out.

–Dennis Normile



Playing catch-up. Although the smaller NTT is closing the gap with AT&T on overall output, the average NTT paper is cited much less often.

A $3 Billion Slice of AT&T

While Japan debates the merits of dividing up Nippon Telegraph & Telephone and its research labs, its U.S. counterpart continues to splinter. Last week AT&T completed the largest initial public stock offering in U.S. history as it launched Lucent Technologies Inc. On 4 April the public bought 112 million shares of the new company, which controls most of the old Bell Laboratories, spending a record $3.025 billion.

Lucent takes with it approximately 75% of the roughly 27,000 research and development experts at Bell Labs, the famed R&D arm of AT&T that introduced such technological benchmarks as the transistor and laser. It will be based in Murray Hill, New Jersey, and its primary focus will be to supply equipment to the telecommunications industry. The remaining 25% of Bell Labs will remain with AT&T, forming the heart of AT&T Laboratories, which will focus its research in areas such as wireless communications and cryptography. That research outfit has yet to select a permanent home. The remaining piece of the one-time monopoly, AT&T, will operate long-distance telecommunications networks. Last fall AT&T announced it would split into three companies by the end of 1996.

Bell Labs, once an oasis for corporate basic research, has dramatically reduced long-range research in recent years in favor of near-term, product-oriented projects. Industrial research analysts say that Lucent will need to do well to allow researchers to continue a variety of projects in fundamental areas ranging from software development to high-speed electronics. If the company falters, predicts Richard Solomon, associate director of the Massachusetts Institute of Technology's research program on communications policy, "the first thing they'll squeeze is R&D."

–Robert F. Service